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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/539,593

06/17/2005

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EXAMINER

HOBAN, MATTHEW E

ART UNIT

PAPER NUMBER

1793

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DELIVERY MODE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/539,593	Applicant(s) SHIRAKAWA ET AL.	
	Examiner Matthew E. Hoban	Art Unit 1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 January 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) 9-21 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 07 January 2008 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Previous Rejection

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4 and 6-8 are rejected under 35 U.S.C. 102(a) as being anticipated by S. Wada et al (S. Wada “Preparation of nm-ordered Barium Titanate Fine Particles using the 2-step Thermal Decomposition of Barium Titanyl Oxalate and Their Dielectric Properties”, Proceedings of the IEEE International Symposium on Applications of Ferroelectrics, 13th, Nara, Japan, May 28-June 1, 2002 (2002), 263-266).

The instant claims detail a barium titanate, which is a powder of single crystals in the form of particles made by wet process, wherein 80% or more of the particles do not contain a void having a diameter of more than 1nm. These particles also have a BET specific surface area of .1 m²/g or more.

The disclosure of Wada teaches the creation of nm-size barium titanate particles that are defect and impurity free (See abstract and pg. 265 column 2). Overall Wada’s invention is a thermally decomposed Barium titanyl oxalate that goes through a modified two step process. Upon completion of this process it was found that the product was single crystal, defect and impurity free, which reads directly on claims 1-3 of the instant application. The exact percentage of defect free particles is not directly recited, however the language of the author leads one to reasonably believe that the particles were nearly all of the particles created were free of defects

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(Relevant to claims 1-3). The particles of Wada were stated as having a size of 16.5 nm, as verified through TEM observation, by simply calculating under the assumption that the particles were perfect spheres this leads to a specific surface area of $62.9 \text{ m}^2/\text{g}$. Other factors in this calculate were density, which was recited as being 5.89 g/cm^3 by Wada. The assumption of the particles being perfect spheres is a sound one, even if the particles were elliptical with a high aspect ratio, their specific surface area would still be much greater than the value of $.1 \text{ m}^2/\text{g}$ as recited by the instant claims (Relevant to claim 4). The final product of Wada's research did not incorporate any dopants or additional elements as recited in claim 6. Finally the products attained by Wada were in the form of powders (See Experimental Section, Paragraph 1) (relevant to claim 7). The major difference between the two processes is the fact that Wada uses a solid state thermal decomposition process, where the applicant uses a wet process; however, the process by which these powders were obtained gives no grounds for patentability, since the final products appear to be exactly the same. Both products are free of internal hydroxyl groups, which cause defects and voids of over 1 nm, and both have relatively high specific surface area, due to their small size (relevant to claim 8).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

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4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claim 5 rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al (S. Wada “Preparation of nm-ordered Barium Titanate Fine Particles using the 2-step Thermal Decomposition of Barium Titanyl Oxalate and Their Dielectric Properties”, Proceedings of the IEEE International Symposium on Applications of Ferroelectrics, 13th, Nara, Japan, May 28-June 1, 2002 (2002), 263-266) in view of Venigalla et al (US Application Number 10/244828, thus forth referred to as ‘828).

The instant application claims a barium titanate, which is single crystal in the form of particles, where 20% of the particles do not have a void greater than 1 nm in diameter. Furthermore, the application claims that there is no abrupt peak detected at around 3500 cm⁻¹ by infrared spectrum analysis of the particles after heat treatment thereof at 700C.

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In reference to the disclosure of the instant application, detection of an abrupt peak at around 3500 cm^{-1} by infrared spectrum analysis refers to the presence of hydroxyl groups in the sample

Wada et al teaches a barium titanate, which is **single crystal** in the form of particles, where the sample is **defect-free and impurity-free** (no voids greater than 1nm in diameter). The paper states that there are no internal hydroxyl groups; however hydroxyls are adsorbed on the surface of the particles (see page 265, column 2). These results were obtained through infrared spectroscopy and thermogravimetric analysis.

The difference between these two products is the fact that the one of the instant claim apparently contains no adsorbed hydroxyl groups, while the product of Wada et al does.

However, the removal of adsorbed hydroxyls is an aspect taught by '828 in the following passage:

“[0020] One method involves heating the barium titanate-based particles to remove hydroxyl groups (i.e., OH.sup.-groups) from particle surfaces. The hydroxyl groups may be ionic species, or may be part of a compound (e.g., H.sub.2O). The hydroxyl groups may be chemically, physically, or otherwise attached or associated with the particle surfaces. In particular, barium titanate-based particles that are produced using a hydrothermal process and conventionally dried generally have hydroxyl groups attached to their surfaces. Thus, such barium titanate-based particles are particularly well-suited to be treated using this heating method. In some cases, hydroxyl groups resulting from hydrothermal processing comprise between about 1% and about 2% of the total weight of the particulate composition. It is to be understood, however, that barium titanate-based particles produced using other processes may also have hydroxyl groups attached to their

surfaces and can be treated using the heating method.

[0021] The hydroxyl groups are removed by heating the particles to a sufficient temperature and for a sufficient time so as to cause the hydroxyl groups to detach from particles surfaces. The specific heating conditions may depend upon characteristics of the particulate composition including composition size and particle size amongst others. Conventional drying temperatures (e.g., 200.degree. C. or less) have been found to be too low to sufficiently remove hydroxyl groups from particle surfaces. The heating step is generally carried out at temperatures and times that are insufficient to cause substantial particle growth and insufficient to cause particle sintering. In one set of embodiments, the particles are heated to a maximum temperature of greater than about 300.degree. C. and less than about 500.degree. C. to remove the hydroxyl groups. In some embodiments, the maximum temperature is between about 350.degree. C. and about 450.degree. C. (e.g., about 400.degree. C.). It may be desirable to maintain the particulate composition at a relatively constant temperature between about 300.degree. C. and about 500.degree. C. for a dwell period. Though in other cases, the particulate composition is heated to the maximum temperature within this range but then cooled without the dwell period.

[0022] Heating time generally depends on the size of the particulate composition and can be readily determined by one of ordinary skill in the art. Any suitable heating system (e.g., furnace, vacuum furnace) can be used to heat the particles. After heating the particles are cooled, generally to room temperature."

Thus, It would have been obvious to one of ordinary skill in the art to remove hydroxyls at the time the invention was filed when Wada is modified in view of US '828 because US '828 teaches the use of the above heating process is said to remove adsorbed hydroxyl groups from barium titanate. Although this process is specifically designed for use with particles obtained through hydrothermal synthesis, the inventor states that barium titanate obtained through other processes can be heat-treated and refined using the above process.

The particles created by Wada only had hydroxyl's adsorbed to the surface, and had no internal lattice hydroxyls. Normally, the removal of hydroxyls would cause defects in the particles; however, these defects are associated with the removal of hydroxyls from the internal cavities of the particles and are not associated with the removal of adsorbed hydroxyls. Since only adsorbed hydroxyls would be removed from Wada's particles, since there were no internal hydroxyls, no defects would arise from the heat treatment proposed by '828. Finally after this heat treatment there would be no hydroxyls adsorbed on the surface of the particles or in the lattice of the barium titanate, meaning that there could be no hydroxyls in or on the particles leading to the absence of an IR peak at 3500 cm^{-1} .

There is significant motivation to combine these two inventions because a particle of barium titanate with less surface impurities leads to a sintered final product with better, more consistent properties. It is well known in the art that hydroxyls, on the surface or internal, decrease the capacitance of any barium titanate capacitor.

Response to Arguments

1. Applicant's arguments filed 1/07/2008 have been fully considered but they are not persuasive. The applicant argues in paragraphs 1-3 of page 12 of his arguments that Wada **does disclose** "nm-size impurity free and defect free barium titanate single crystal powder particles", but **does not disclose** or suggest "barium titanate particles wherein 20% or more by number of the total do not contain a void having a diameter of 1 nm or more".

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2. Wada as stated earlier, claims to have produced "**impurity free**" and "**defect free**" particles. Generally, defects in a crystalline solid refer to any disturbance in the periodic crystalline structure of the material. These disturbances can range from a grain boundary to much larger defects such as void/pores. On the other hand, an impurity refers to differences in composition.
3. The disclosure of the instant application even refers to voids as defects in paragraph 5 of page 7, where it is stated that "defects resulting from removal of hydroxyl groups" refers to "voids" having a diameter of 1 nm or more detected through TEM observation.
4. It is reasonable to believe that the particles of Wada are essentially defect-free because he refers to the collection of particles as such, rather than referring to a singular or isolated particle (Line 3-4 of abstract--"**impurity free and defect free nm-sized barium titanate BaTiO₃ particles**" (emphasis added)). This leads a reasonable person to believe that **essentially** all of the particles would be defect and impurity free. An exemplary TEM image is provided in the publication on page 265, which also shows a seemingly perfect single crystal under TEM observation. There is no disturbance in the lattice of this particle, meaning there are no voids, dislocations or grain boundaries.
5. Furthermore, as stated earlier defects in Barium Titanate are due to the removal of hydroxyl groups, which leave voids having a diameter of 1 nm or more. It is stated by Wada specifically on page 265, column 2, that his barium titanate contains no lattice hydroxyl groups, only adsorbed hydroxyl and carbonate groups. Since no lattice-hydroxyl groups are present within the barium titanate, no voids can be produced due to the removal of such lattice groups.

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6. The applicant argues in paragraphs 4-7 on page 12 of their arguments that the density of Wada's particles are less than the theoretical density of barium titanate having a Ba/Ti ratio of 1. The applicant asserts that this indicates that Wada's particles must have voids. This argument fails to take in to consideration other factors, which can lead to perturbations in the apparent density of nanoparticles. In barium titanate it has been shown that the c/a ratio is affected by many factors, namely the particle size (see Page 4860-4861 of Wada et al, "Synthesis of nm-sized barium titanate crystallites using a new LTDS method and their characterization). Variations in particle size greatly affect the lattice parameter of the barium titanate, where smaller particles have larger lattice parameters, where it was seen in this study that the lattice parameter can increase by as much as .028 angstroms. Furthermore, it was stated that a pycnometer was used to measure the density of the nanoparticles, which is an aqueous method (see column 2, page 265). It was also stated that there are adsorbed gas species such as carbonate and hydroxyls on the surface of the barium titanate. In an aqueous method, these adsorbed gases would decrease the apparent density of the particles. Since these nanoparticles are around 17 nm in diameter, the effects of this adsorbed layer could be quite dramatic. Lastly, it has been clearly stated by Wada in his abstract that the particles are defect and impurity free, meaning that the discrepancy in density could not be attributed to voids, since voids are considered defects. It should be noted that no theoretical density or experimental density is cited by the instant application.

7. In regards to the USC 103 rejection of claim 5 based on Wada in view of Venigalla, applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general

allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

8. Applicant's argument in regards to the Provisional Rejection based on Obvious-type Double Patenting are not persuasive, so this rejection has been upheld.

9. Alterations made to the claims and the specifications as a result of objections and 112 rejections made by the examiner are noted. The objections and rejections based on USC 112 are thus withdrawn. Also, in his remarks on page 1, the applicant makes note of the inconsistency regarding the NPL document, WPI XP002277918. This document has been received and considered by the examiner.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew E. Hoban whose telephone number is (571) 270-3585. The examiner can normally be reached on Monday - Friday from 7:30 AM to 5 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jerry Lorengo can be reached on (571) 272-1233. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MEH

/Jerry A Lorengo/
Supervisory Patent Examiner, Art Unit 1793